

Layer00 Efficiency Studies

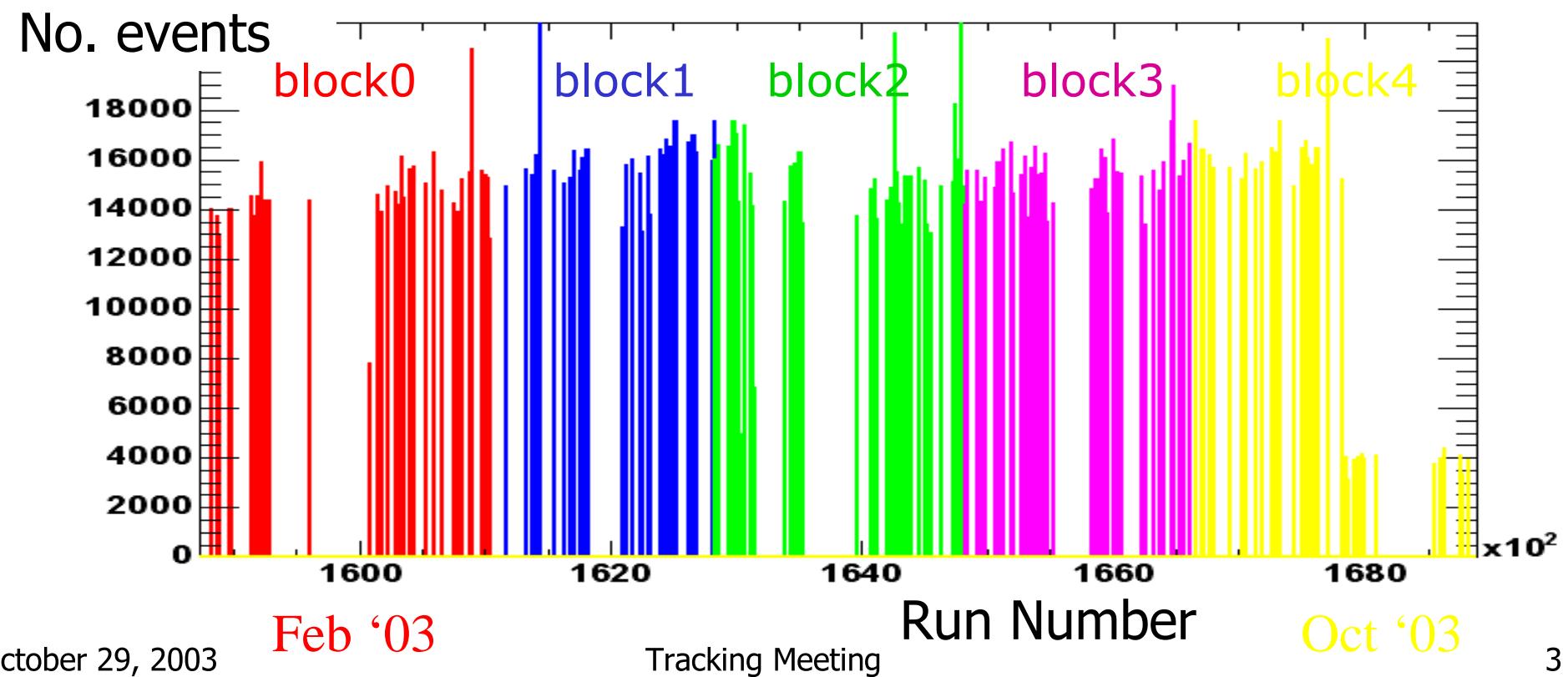
Stephen Levy, UChicago

Method

- Dataset id (name) jpmm09 (JPSIMUMU-07)
 - 4.8.4a production
 - Look at 2003 data : runs [158733,168889]
- Offline release 5.1.0pre10
- Local alignment set 100034 44 TEST
- Run TrackRecoSequence making L00 clusters (w/out applying cluster cuts) but not adding them to tracks
- Use Matt's SiHitAnalyzerModule to study quality / efficiency of unbiased Lyr00 cluster closest to track

Method (cont.)

Lots of statistics. Divide sample into 5 chronological segments (arbitrarily) to study stability of performance.



Efficiency definition

- Track selection
 - No COT only trks ($\text{trkAlg} \neq 16$)
 - Must have hits in at least 2 phi & zed SVXII layers
 - Si trk $\chi^2/\text{dof} < 5$
 - d_0 corrected to SVX beam line $< 200\mu\text{m}$
 - P_t cut applied at times (will be stated)
- Use SiExpected to count no. of times we expect to find a matching cluster for each Lyr00 ladder(can be 2 expected ladders due to overlapping phi region)
- Count no. of clusters we find in each ladder
- Count no. of clusters passing “standard” Lyr00 cuts in each ladder

Efficiency definition (cont.)

- Standard cluster cuts
 - No bad strip or neighbor
 - $N_{\text{strip}} < 6$ (is this correct?)
 - Total cluster $Q < 100$
 - Maximum strip $Q < 50$
 - Maximum strip noise < 3.5

$$\text{efficiency} = \frac{\text{no. findable}}{\text{no. found}} \cdot \frac{\text{no. found}}{\text{no. pass cuts}}$$

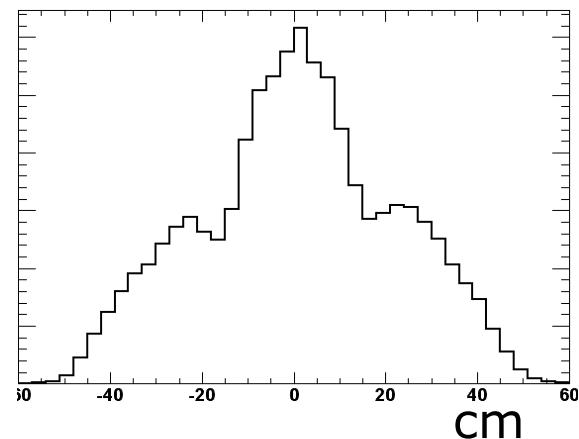



detector problem **algorithm problem**

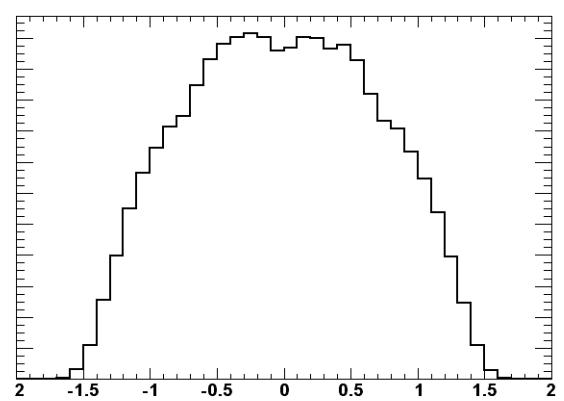
Track Distributions

- Each run block contains about 475k tracks passing cuts
- About 15% of these are expected to intersect two Lyr00 phi wedges

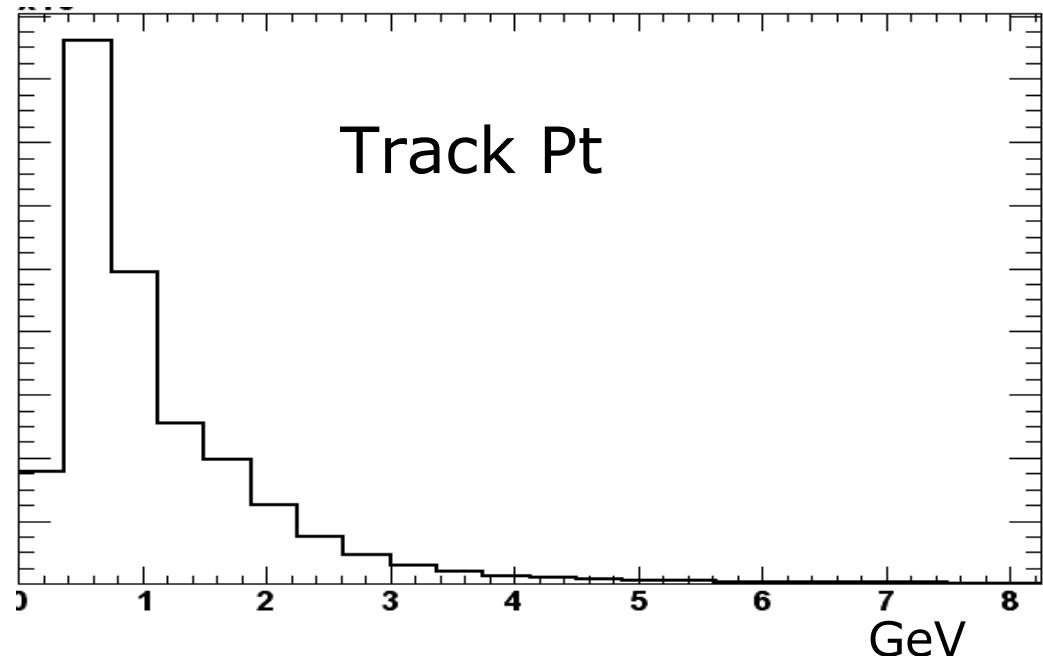
Track z_0



Track η

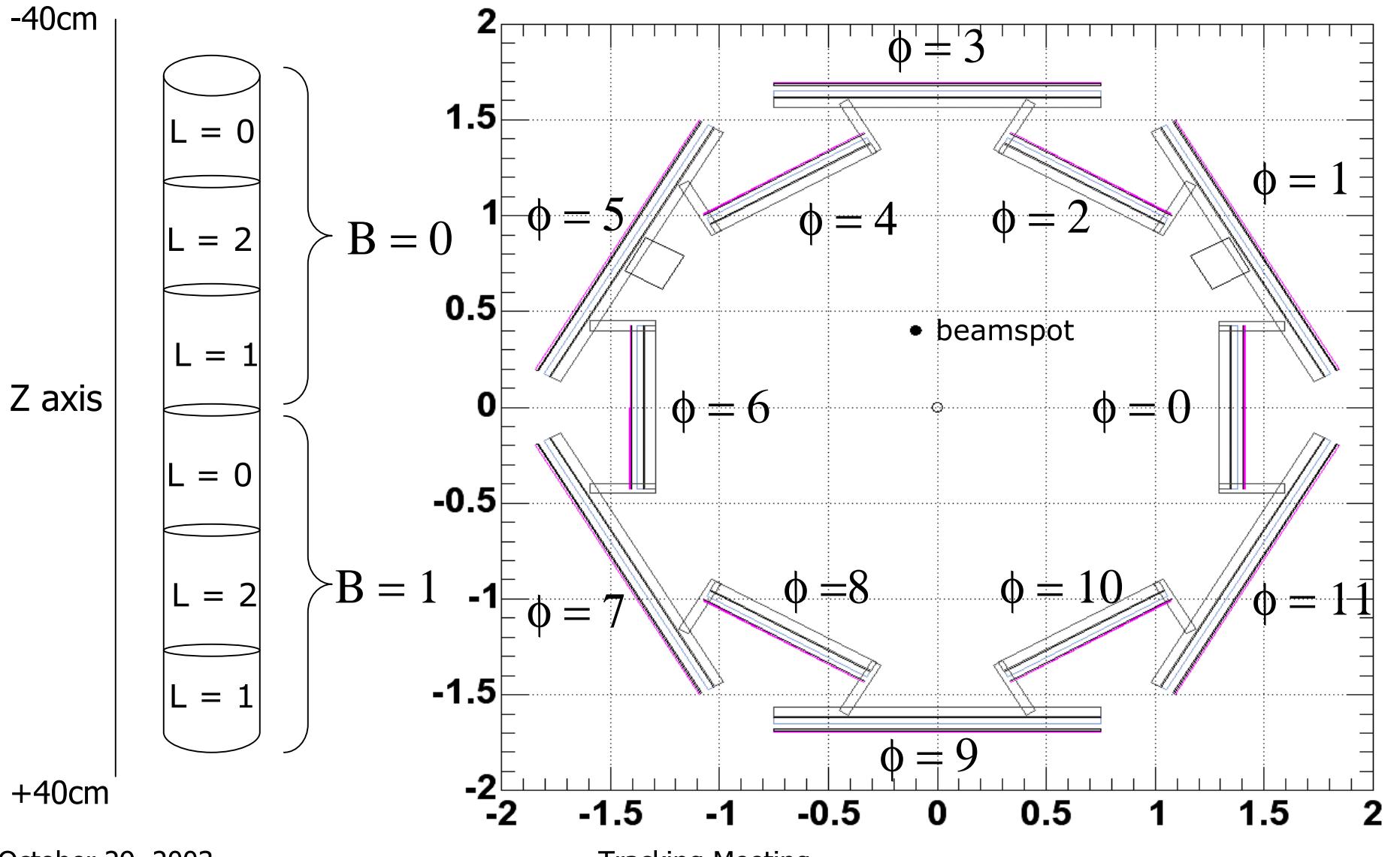


Track Pt



Tracking Meeting

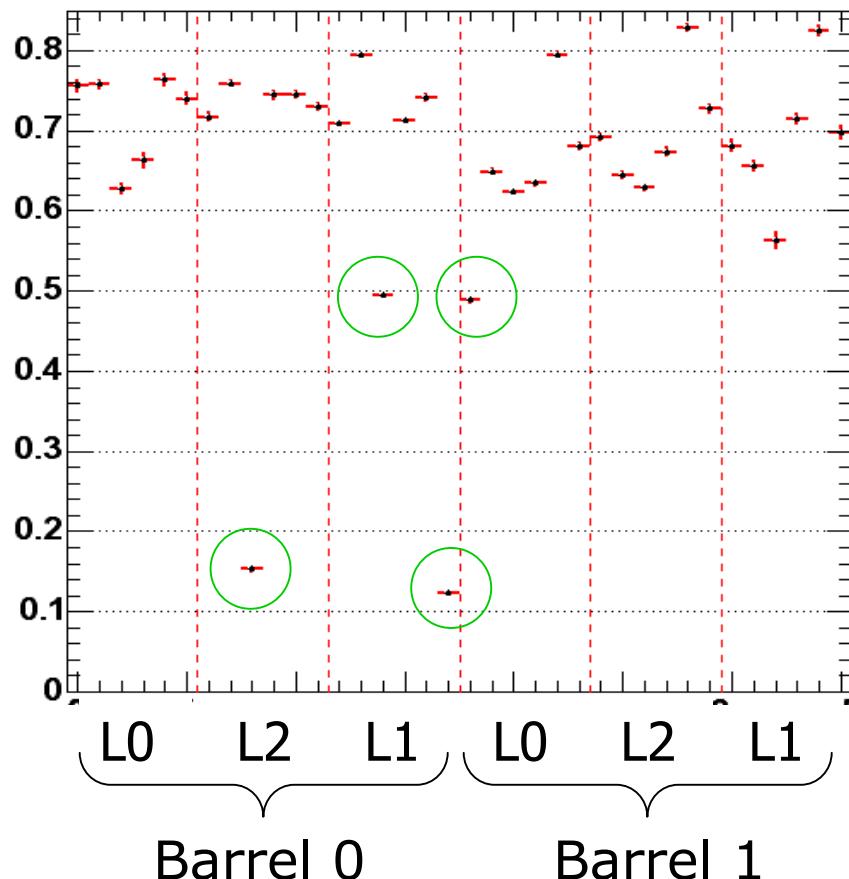
Recall Lyr00 Geometry



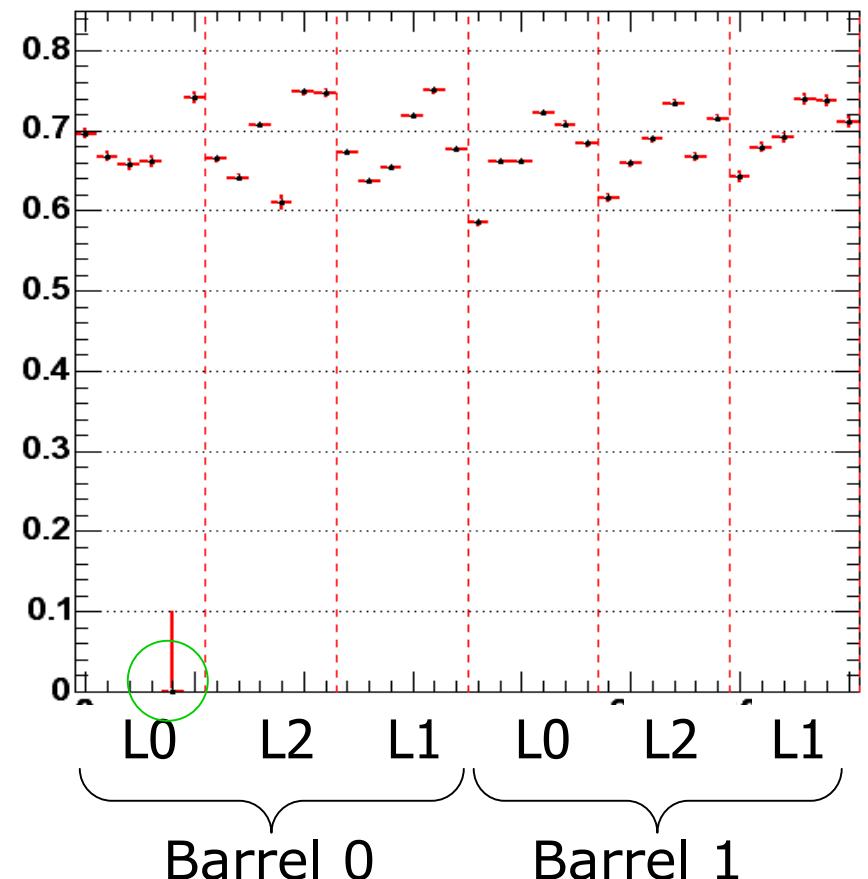
Efficiency by ladder

Block0 data

Inner Layer (ϕ even)



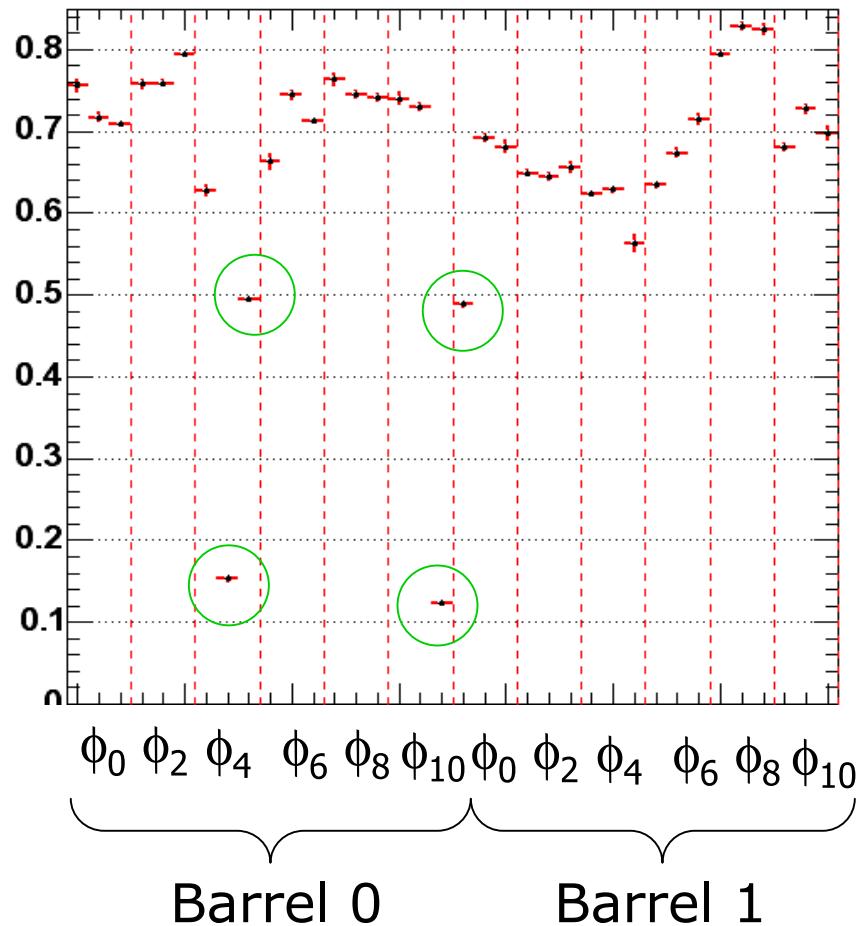
Outer Layer (ϕ odd)



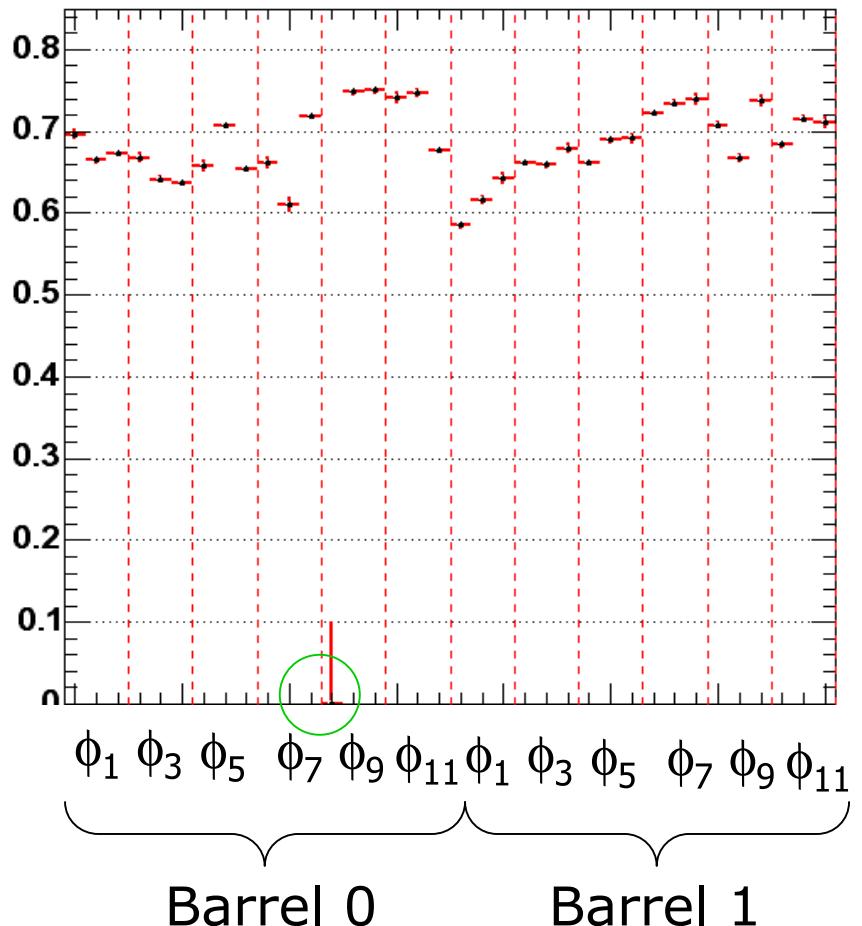
Efficiency again

Same information but different visualization

Inner Layer (ϕ even)



Outer Layer (ϕ odd)



Some comments

- Integrated efficiency $\sim 65\%$ (skewed by low eff central ladders)
- B0 L9 $\phi 0$ is known to be unbiased (loose junction card)
- Two inner ladders show eff $\sim 15\%$
 - B0 L2 $\phi 4$
 - B0 L1 $\phi 10$
- Two inner ladders show eff $\sim 50\%$
 - B0 L1 $\phi 4$
 - B1 L0 $\phi 0$
- Efficiency shows ϕ dependence (more obvious visually for outer radius)

Phi-dependent efficiency

- Split outer radius ladders into upper ($\phi=1,3,5$) and lower ($\phi=7,9,11$) hemisphere
- Split inner radius ladders into 4 closest ($\phi=0,2,4,6$) and 2 farthest ($\phi=8,10$) from beamspot
- Compare absolute cut rate for detector halves (absolute means cluster failed given cut / total clusters)
- Compare “n-1” (after all other cuts applied) cut rate for detector halves.

Inner radius cut comparison

Red = det. top

Blue = det. bottom

Bin 0 : $Q_{\text{total}} < 100$

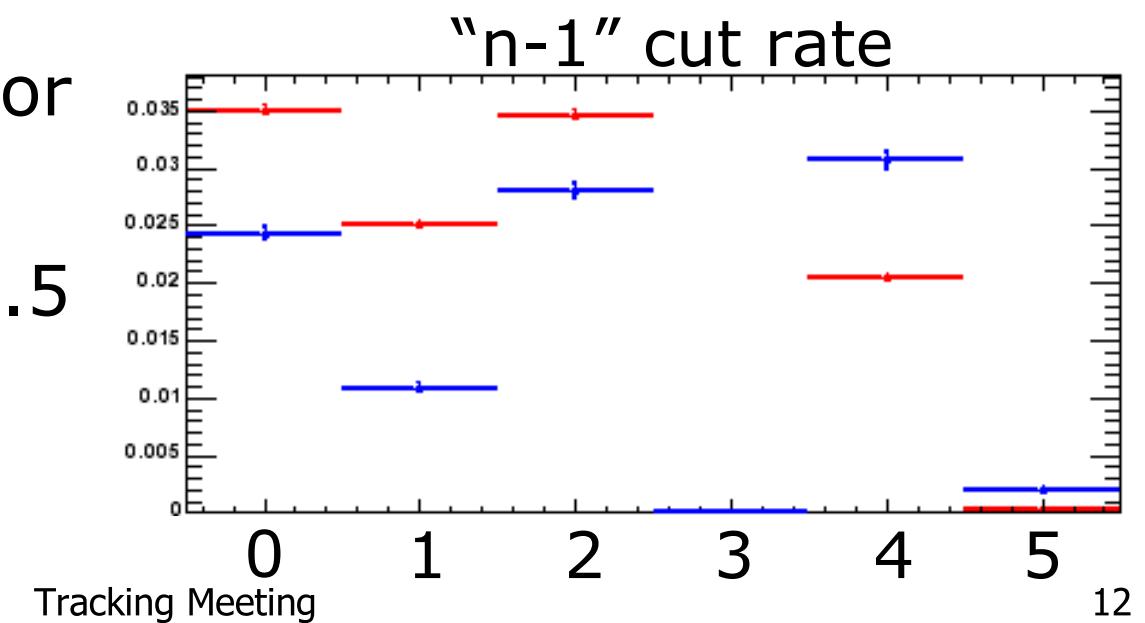
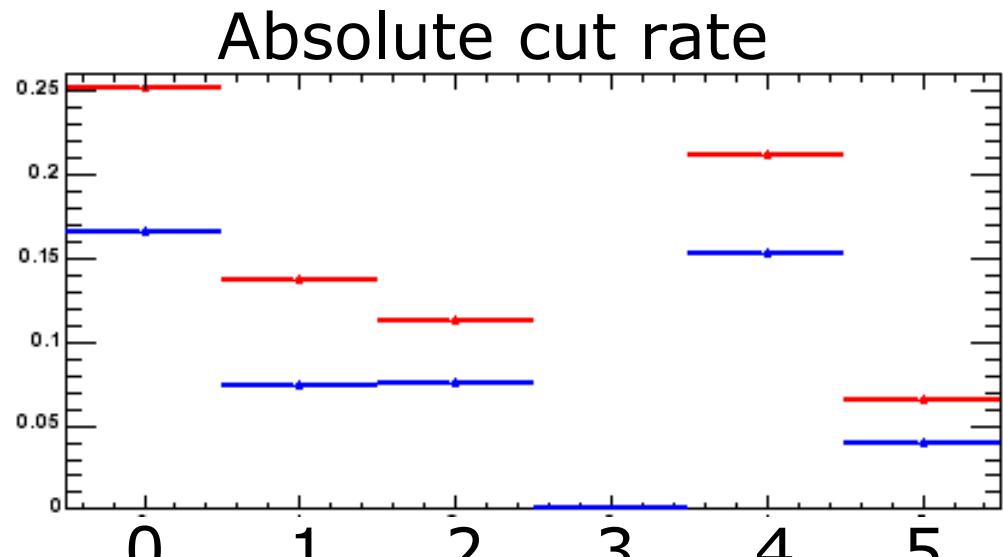
Bin 1 : No. strip < 6

Bin 2 : No bad strip

Bin 3 : No bad neighbor

Bin 4 : $Q_{\text{max}} \text{ strip} < 5$

Bin 5 : $\text{Noise}_{\text{max strip}} < 3.5$



Outer radius cut comparison

Red = det. top

Blue = det. bottom

Bin 0 : $Q_{\text{total}} < 100$

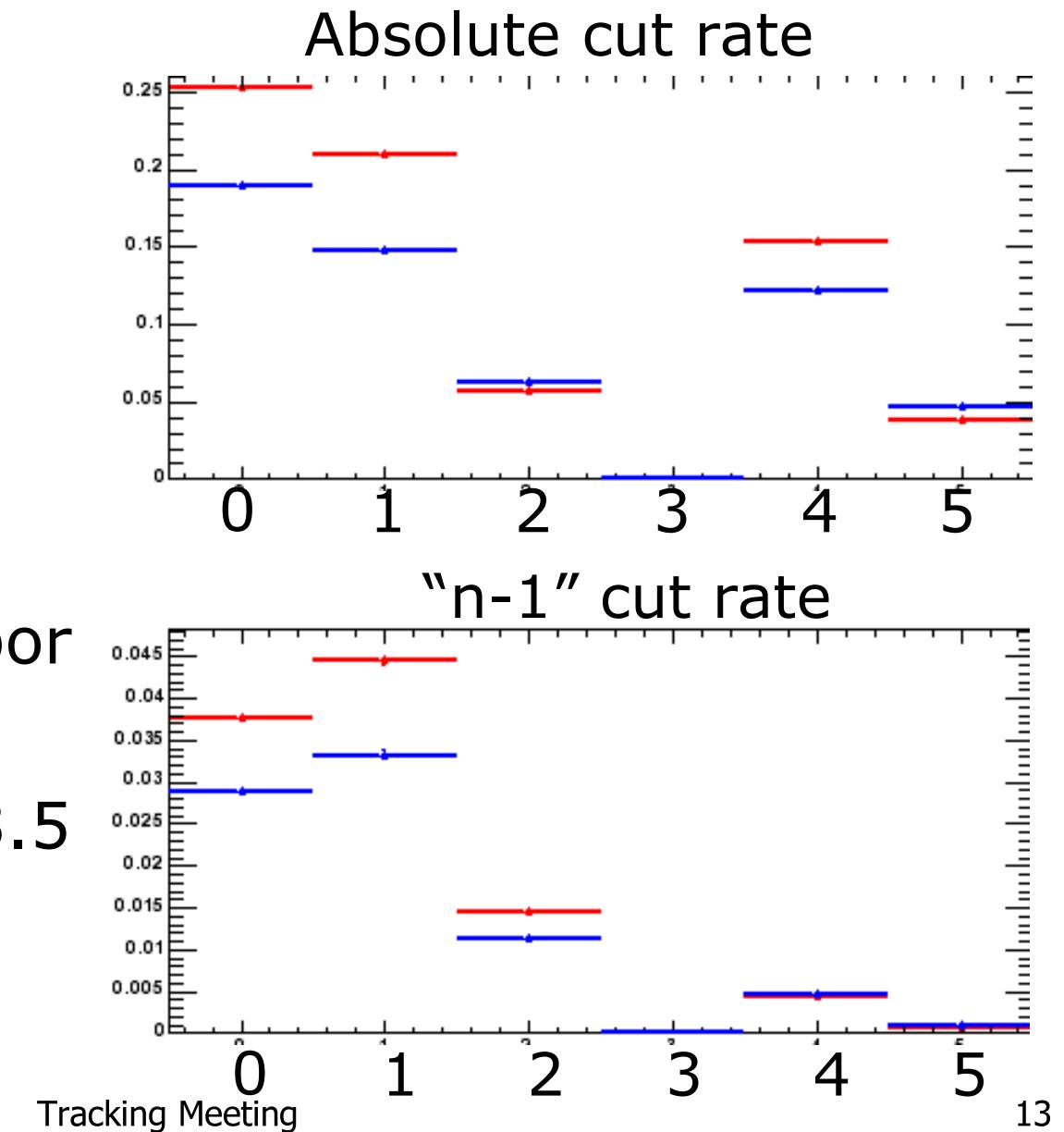
Bin 1 : No. strip < 6

Bin 2 : No bad strip

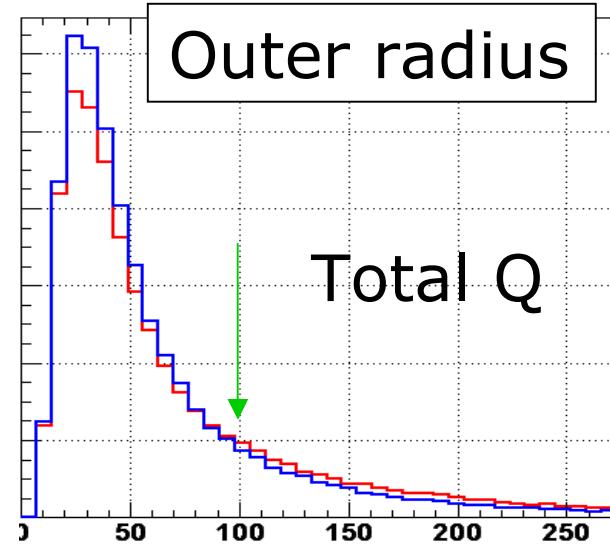
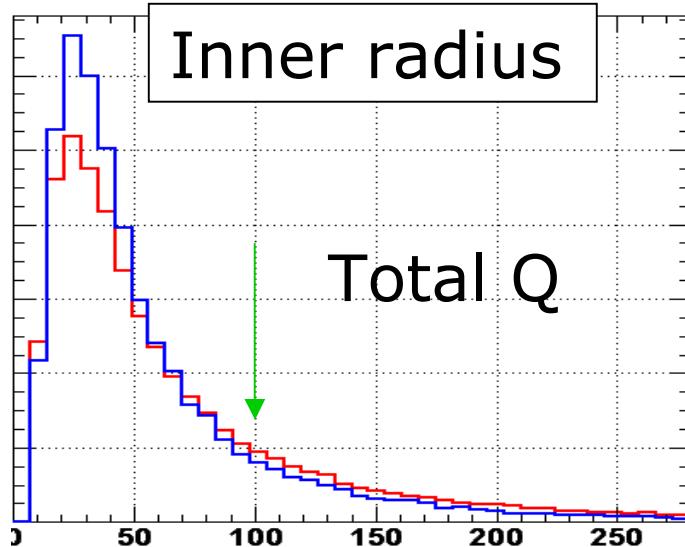
Bin 3 : No bad neighbor

Bin 4 : $Q_{\text{max}} \text{ strip} < 5$

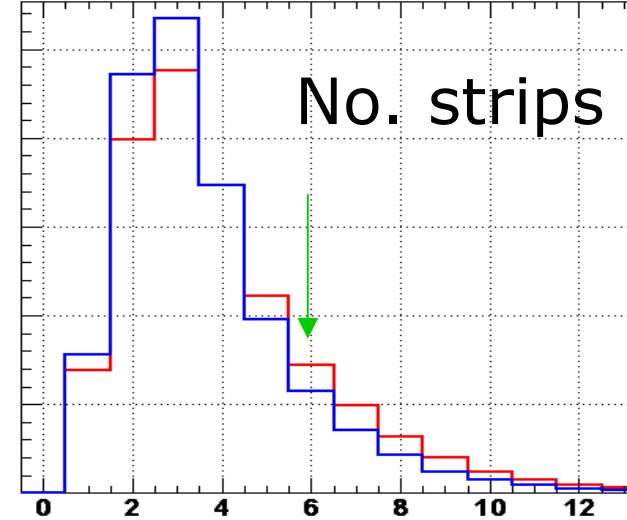
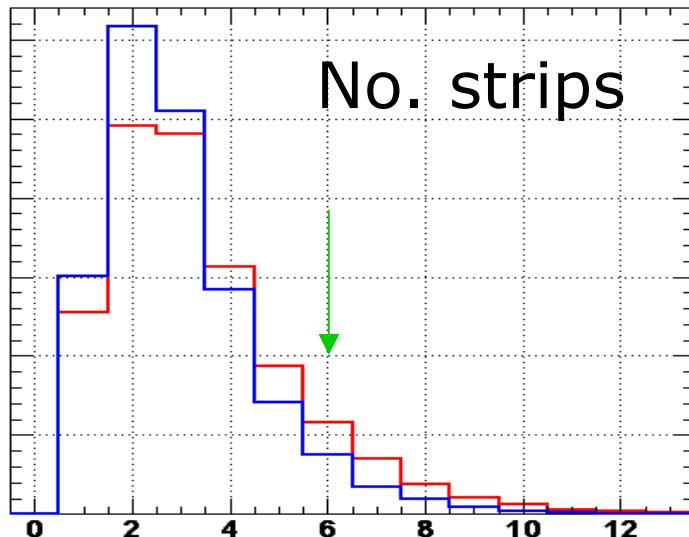
Bin 5 : $\text{Noise}_{\text{max strip}} < 3.5$



Compare inner/outer absolute cut shapes



Larger path length through silicon for det. top ladders



Red = det. top
Blue = det. bot

Hists are normalized to equal entries

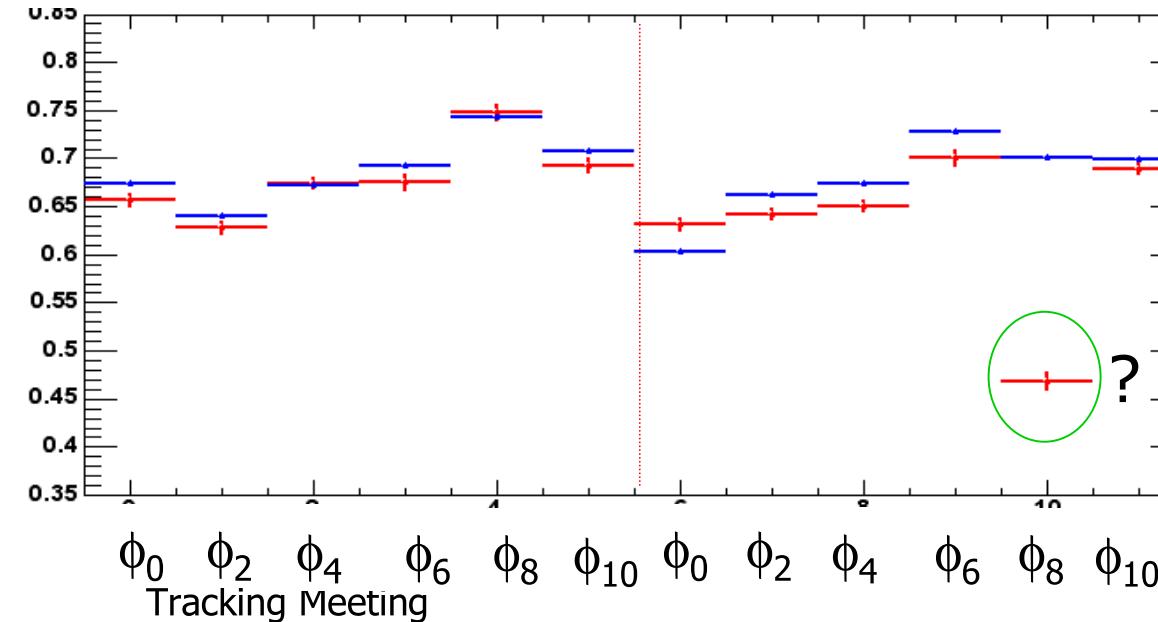
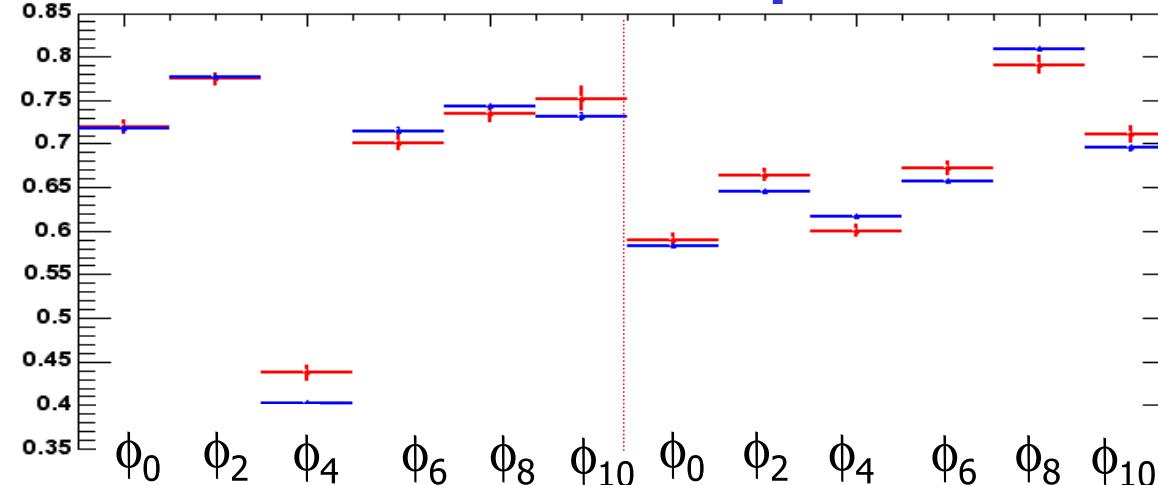
Is phi efficiency dependency correlated with track pt?

Inner radius eff

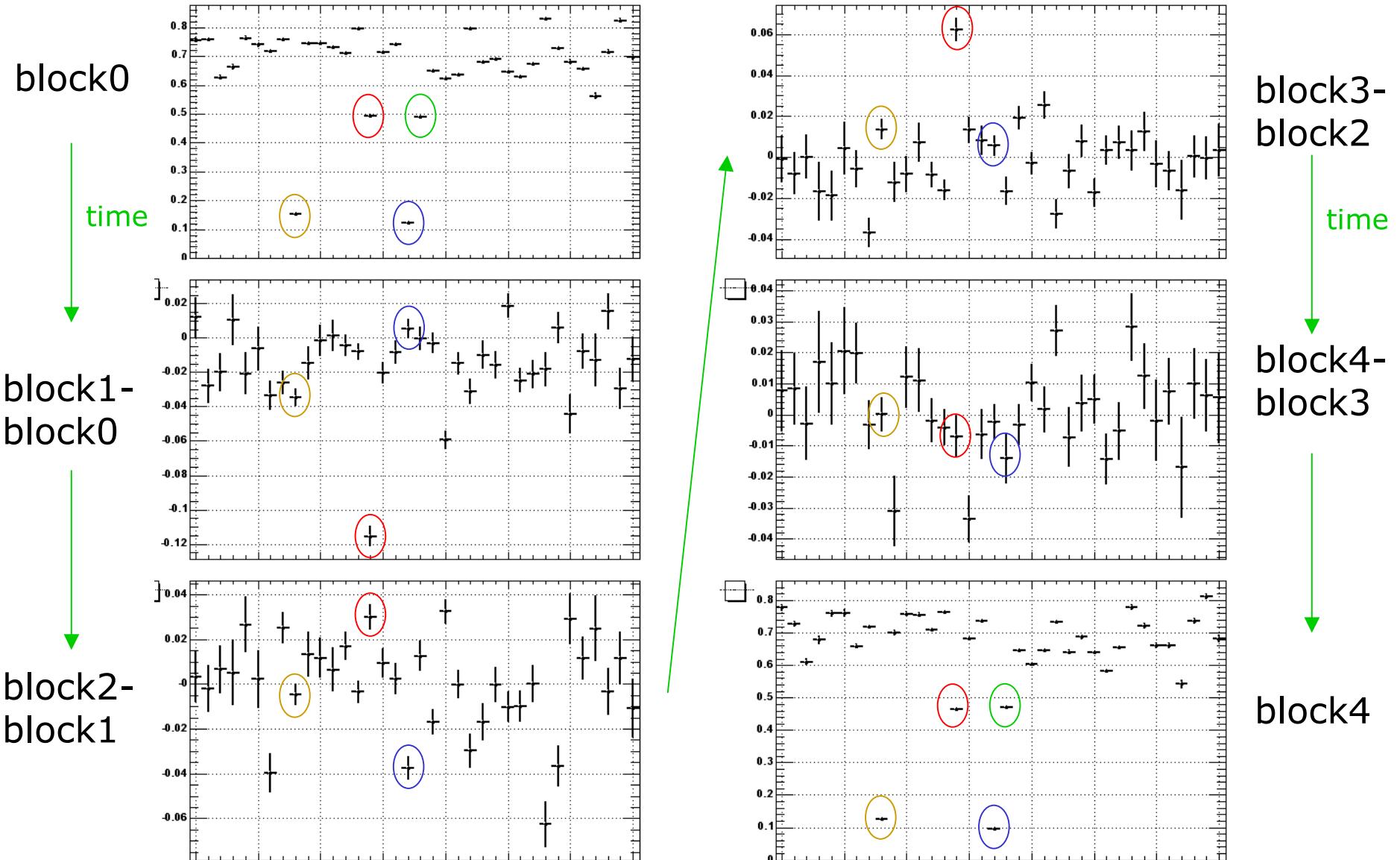
Integrate over
ladders (0,1,2)
for each barrel

Red = trk pt >2
Blue = trk pt <2

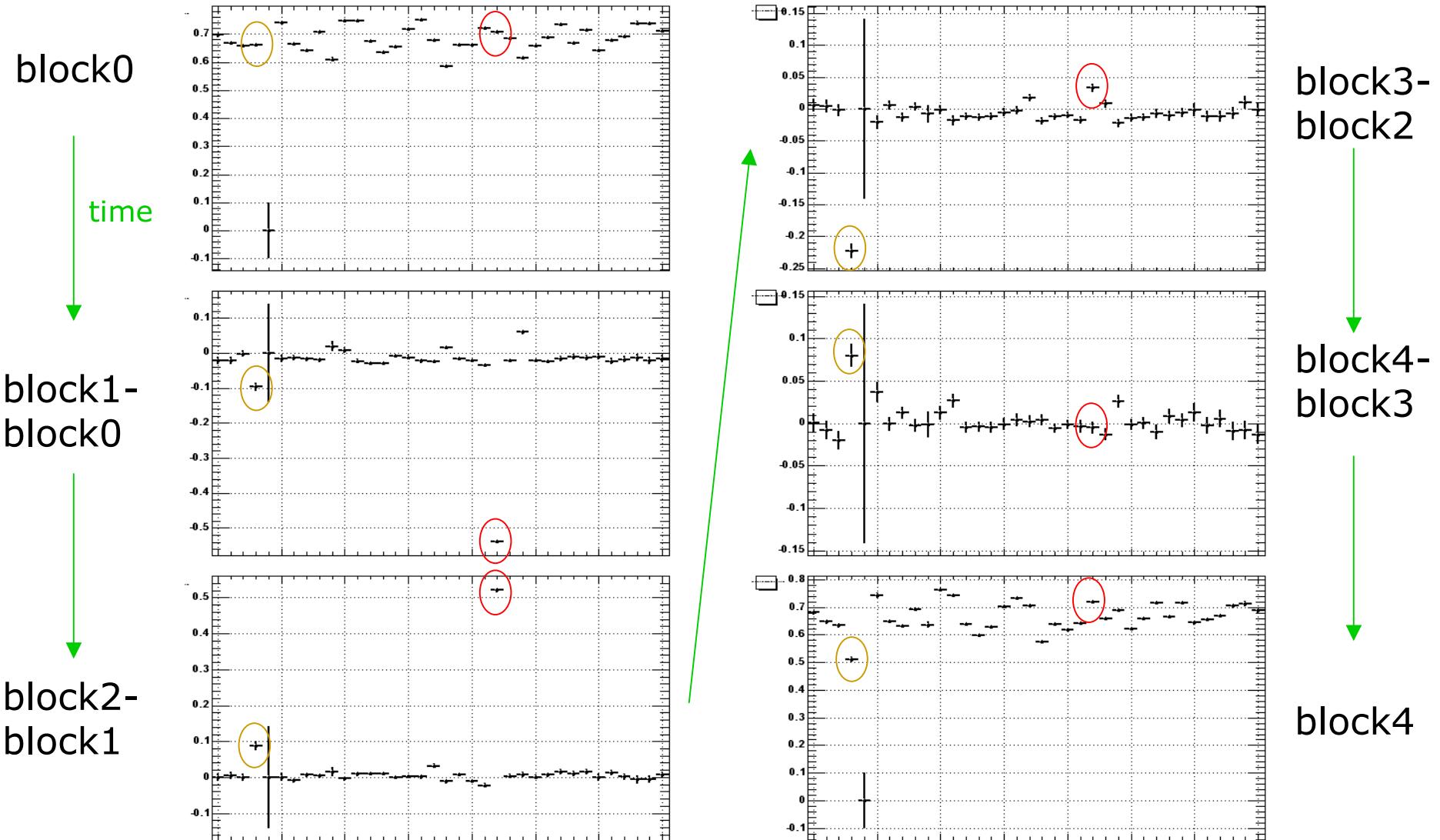
Outer radius eff



How stable is inner radius efficiency in time?



How stable is outer radius efficiency in time?

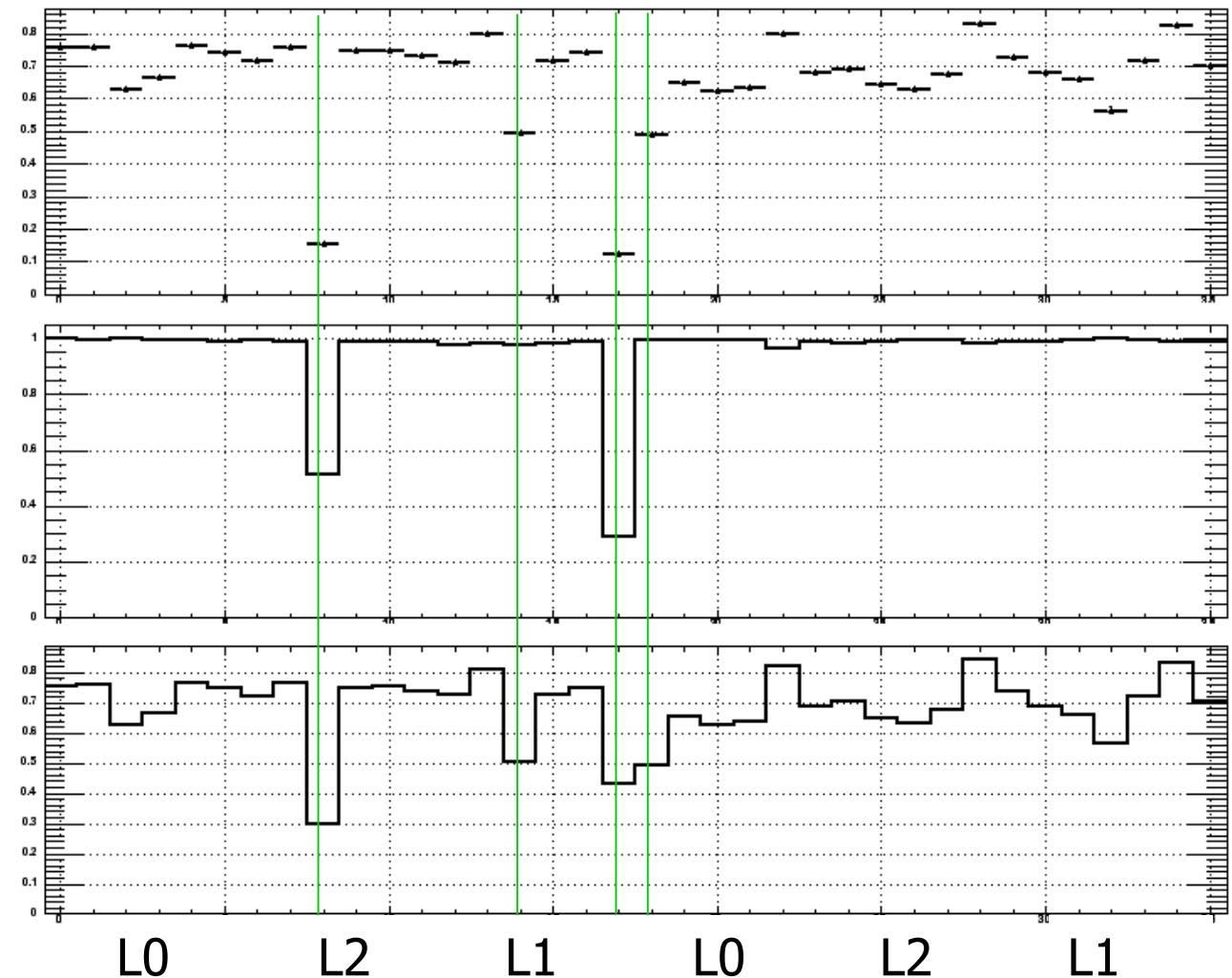


What's wrong with the low efficiency inner radius (<50%) ladders?

$$\text{efficiency} = \frac{\text{no. pass}}{\text{no. expected}}$$

$$\frac{\text{no. found}}{\text{no. expected}}$$

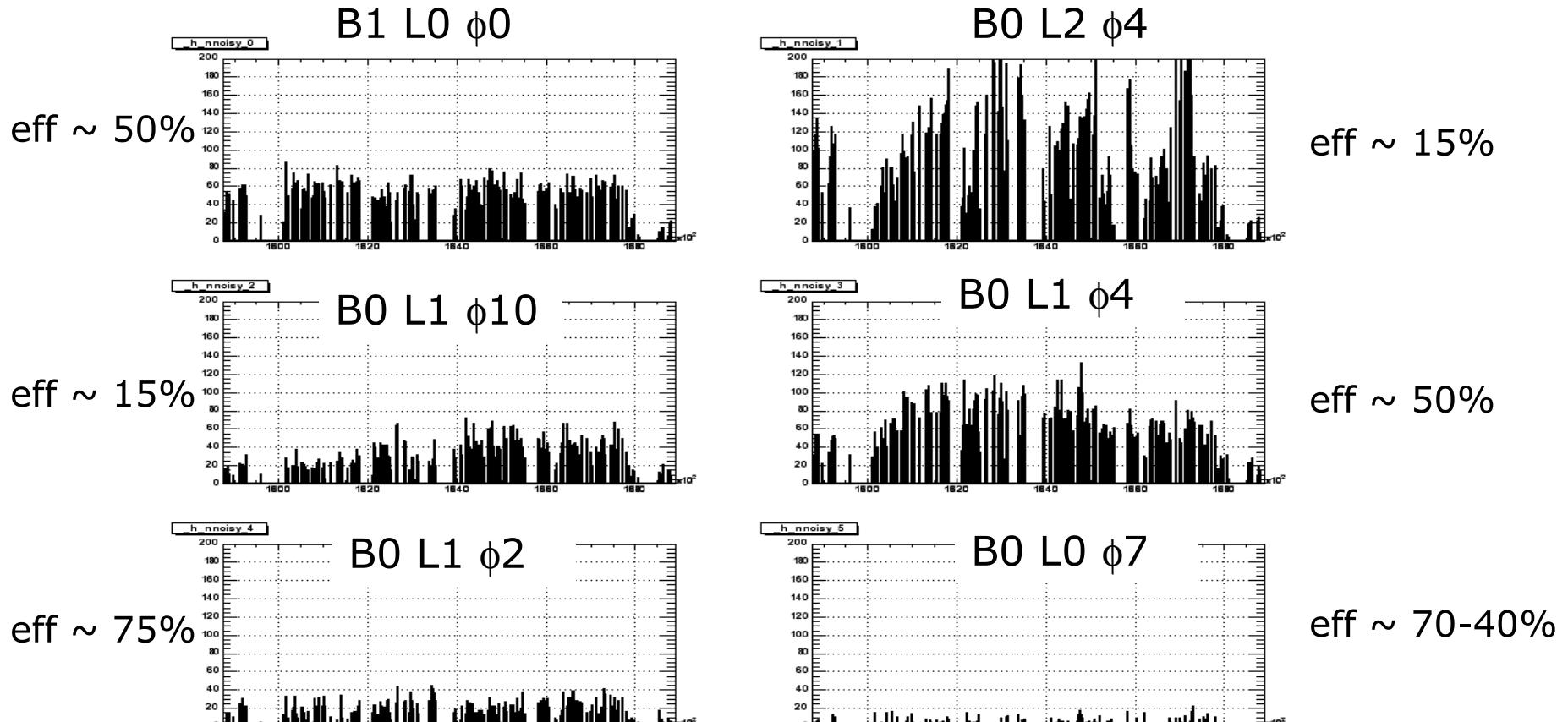
$$\frac{\text{no. pass}}{\text{no. found}}$$



Low efficiency inner radius ladders

- Two have problems forming clusters
B0 L2 $\phi 4$ & B0 L1 $\phi 10$ (eff < 20%)
- Two have clusters that fail quality cuts significantly more than avg
B0 L1 $\phi 4$ & B1 L0 $\phi 0$ (eff < 50%)
- SiExpected does not expect readout problems with these ladders
(errorWord=0)
- Compare quality of clusters in these ladders with normal efficiency ladders

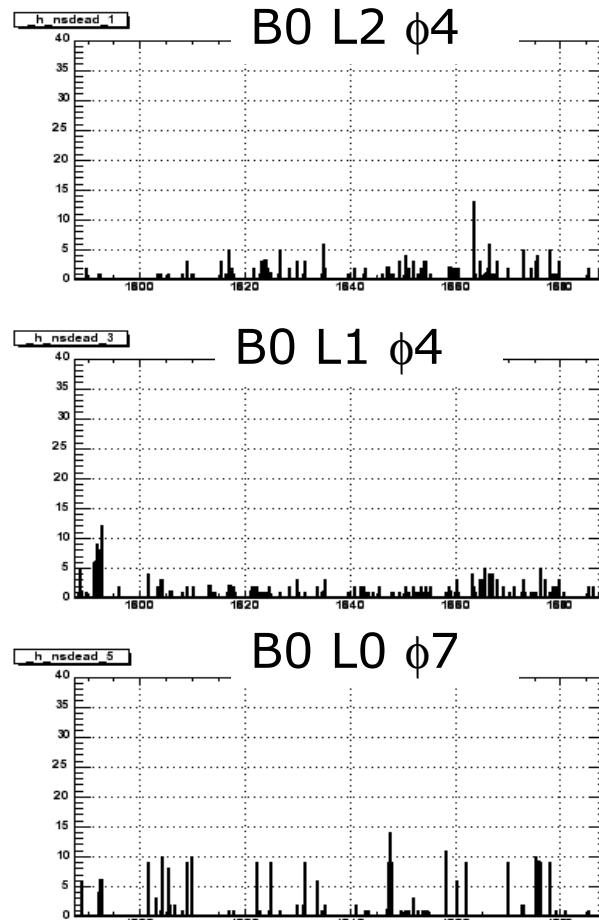
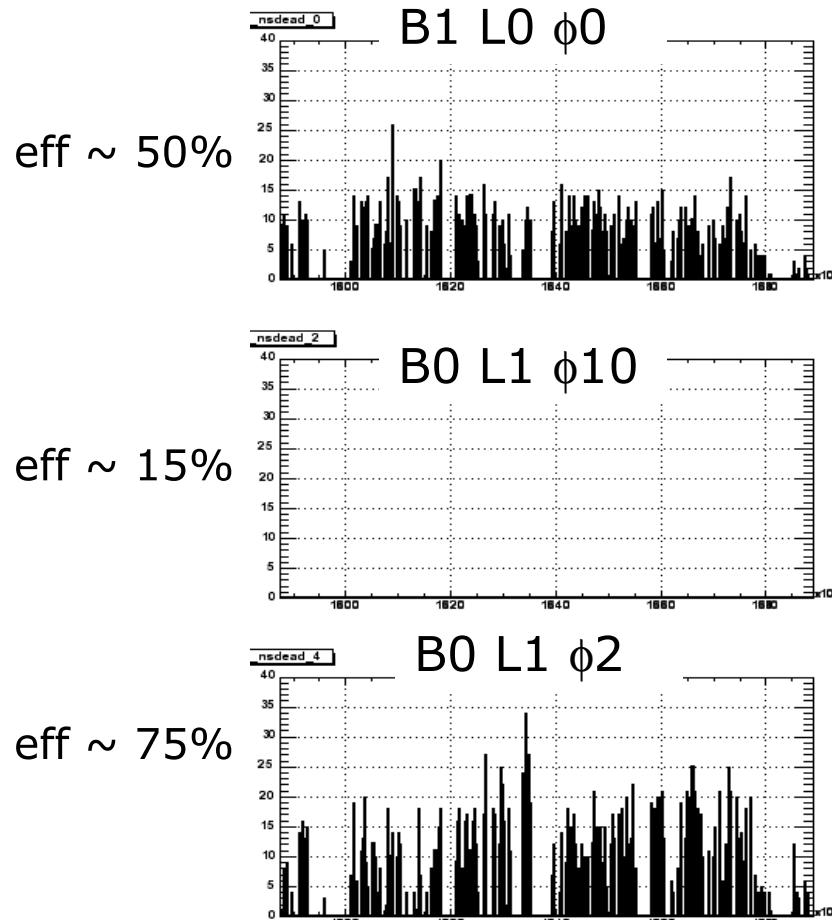
No. noisy strips in cluster closest to track by run for given ladders



Compare number of noisy clusters by run for low eff upper
4 ladders and normal eff inner radius (bot. left)

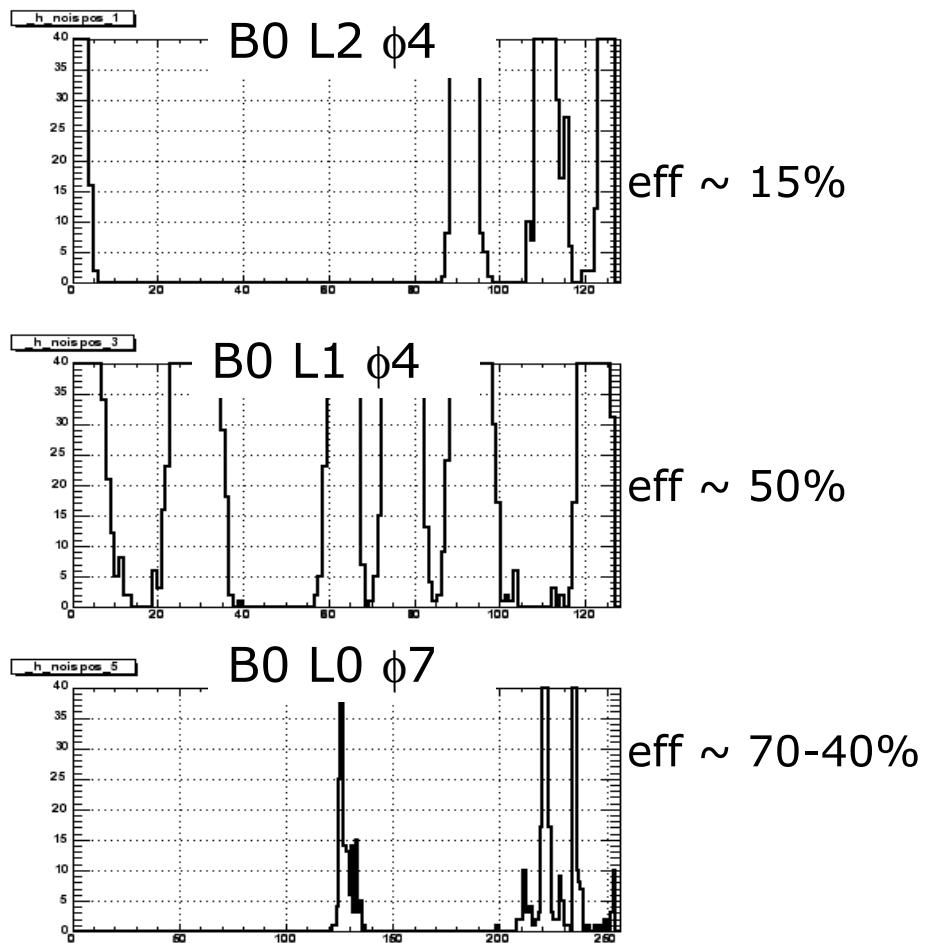
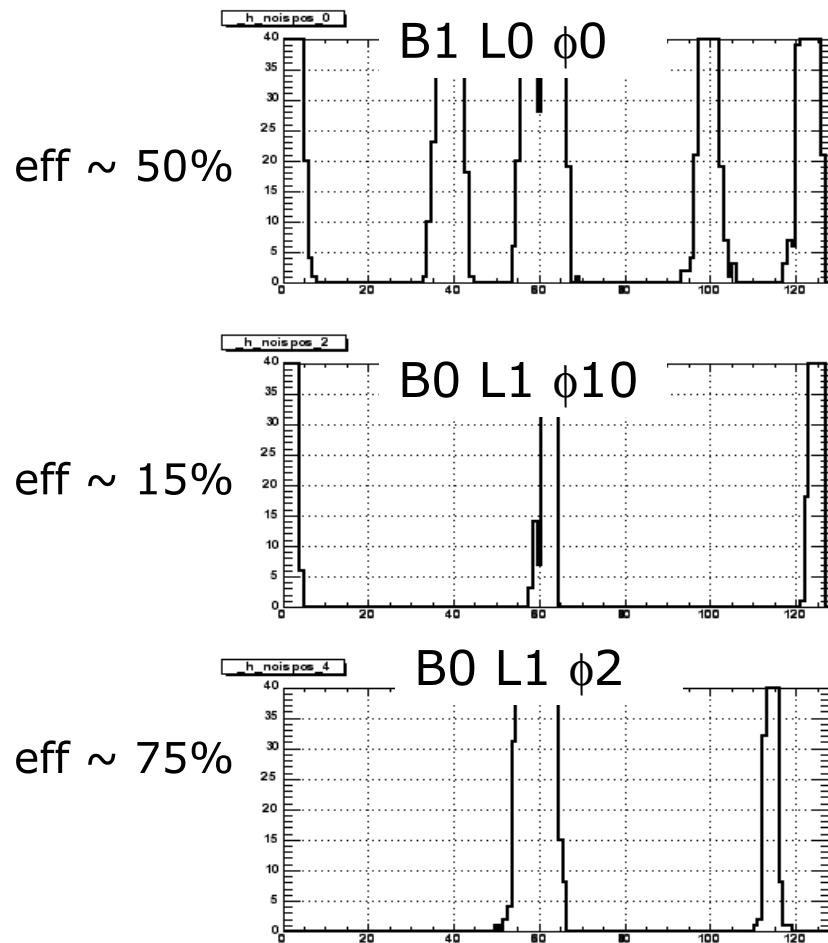
Just looking for some gross pathology

No. dead strips in cluster by run



Compare number of clusters containing dead strips by run for
low eff upper 4 ladders and normal eff inner radius (bot. left)
Just looking for some gross pathology

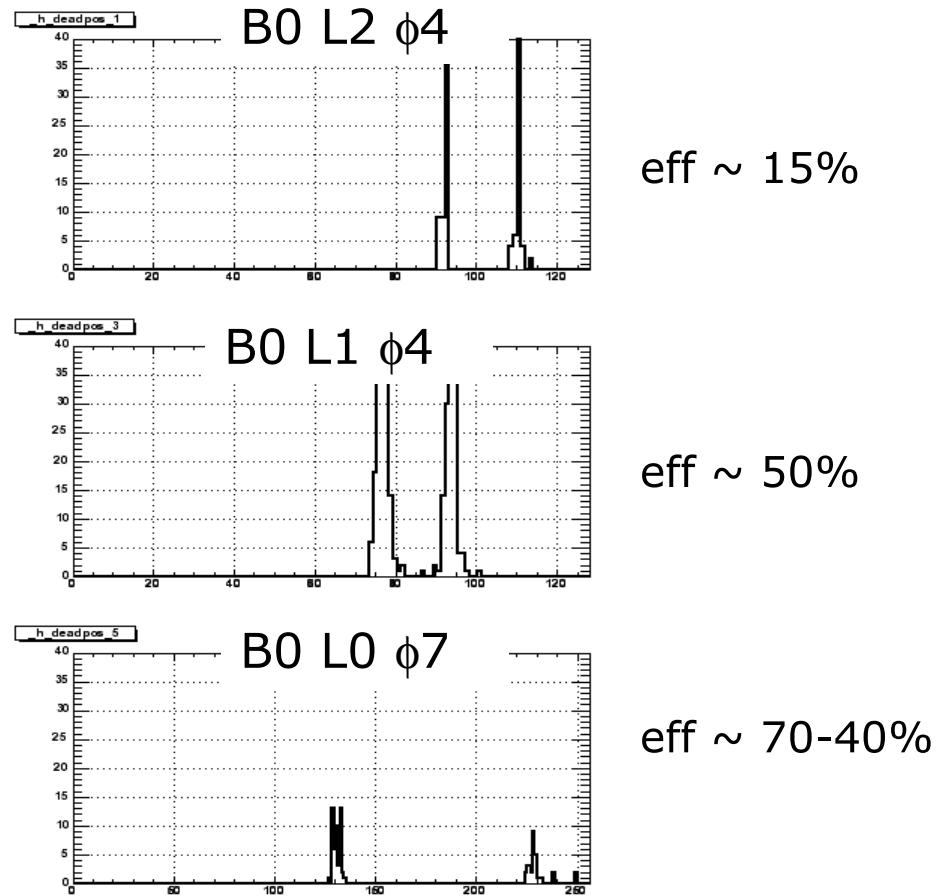
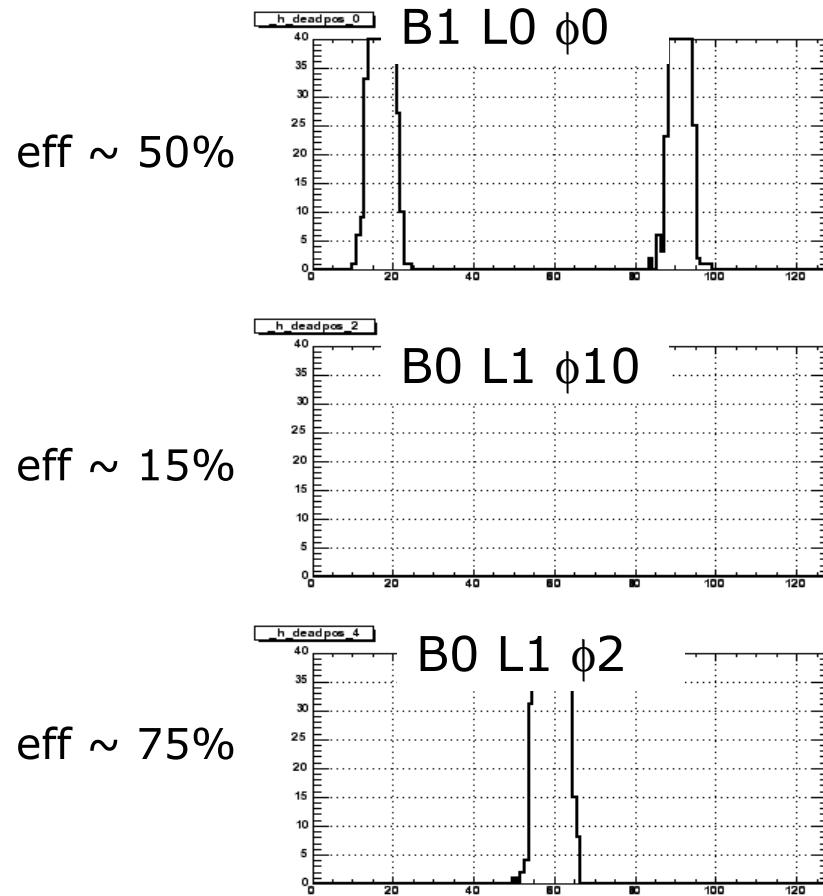
Noisy strip position (units of pitch)



Compare position of noisy cluster strips for low eff upper 4 ladders and normal eff inner radius ladder (bot. left)

Expect edge (& middle) effects

Dead strip position (units of pitch)

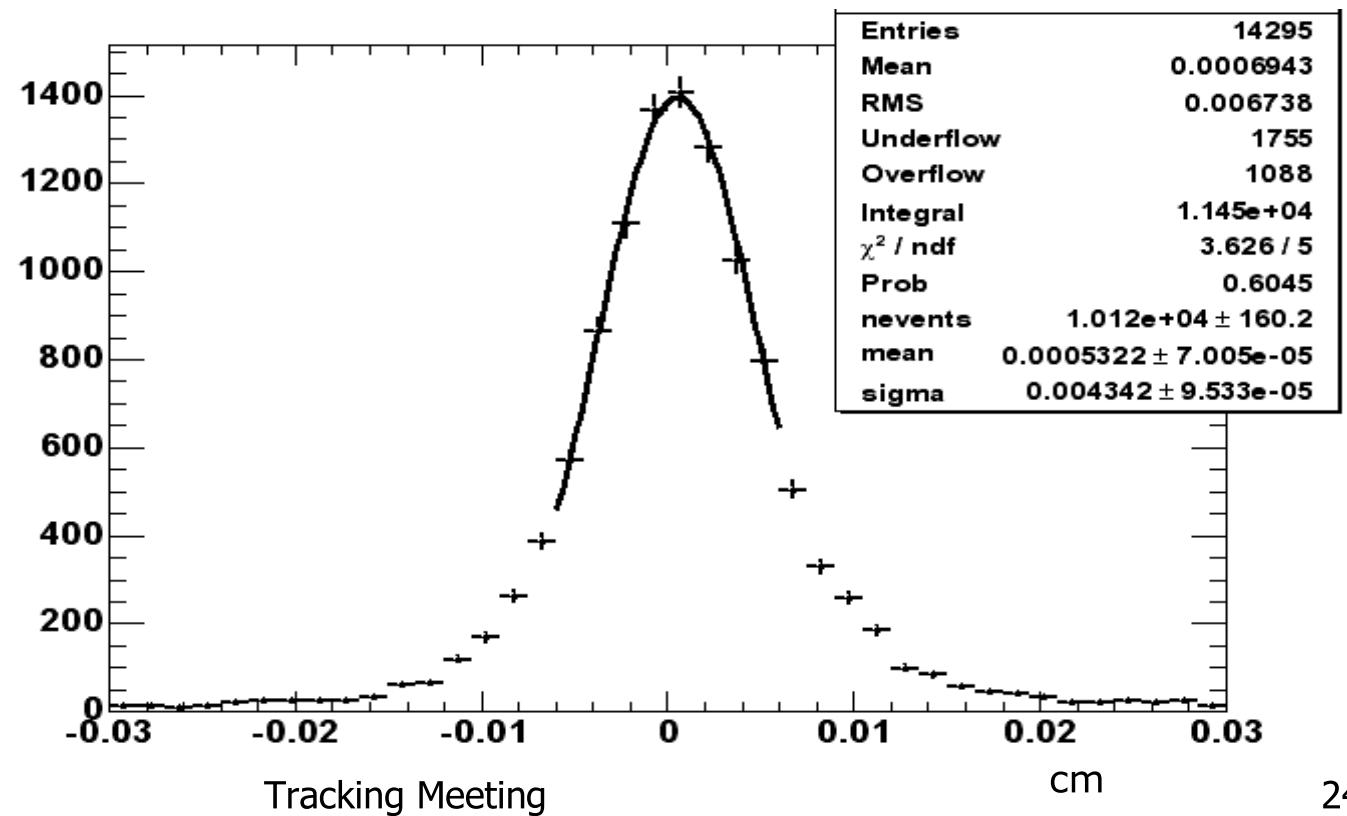


Compare position of dead strips for low eff upper 4 ladders
and normal eff inner radius ladder (bot. left)

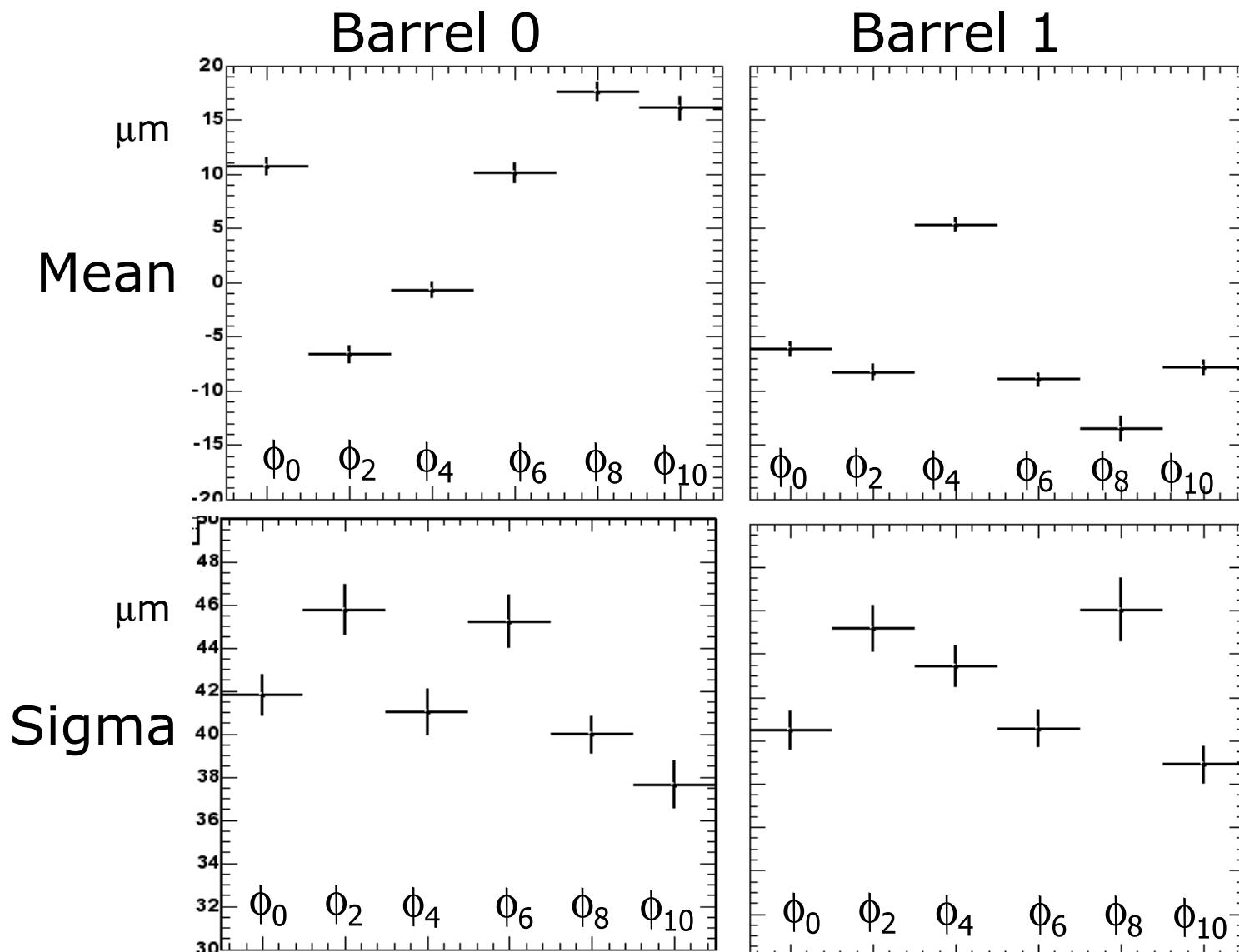
Residuals for good clusters

- Plot residual for each barrel and ϕ wedge (integrate over ladders=0,1,2)
- Fit to gaussian from $\pm 60\mu\text{m}$

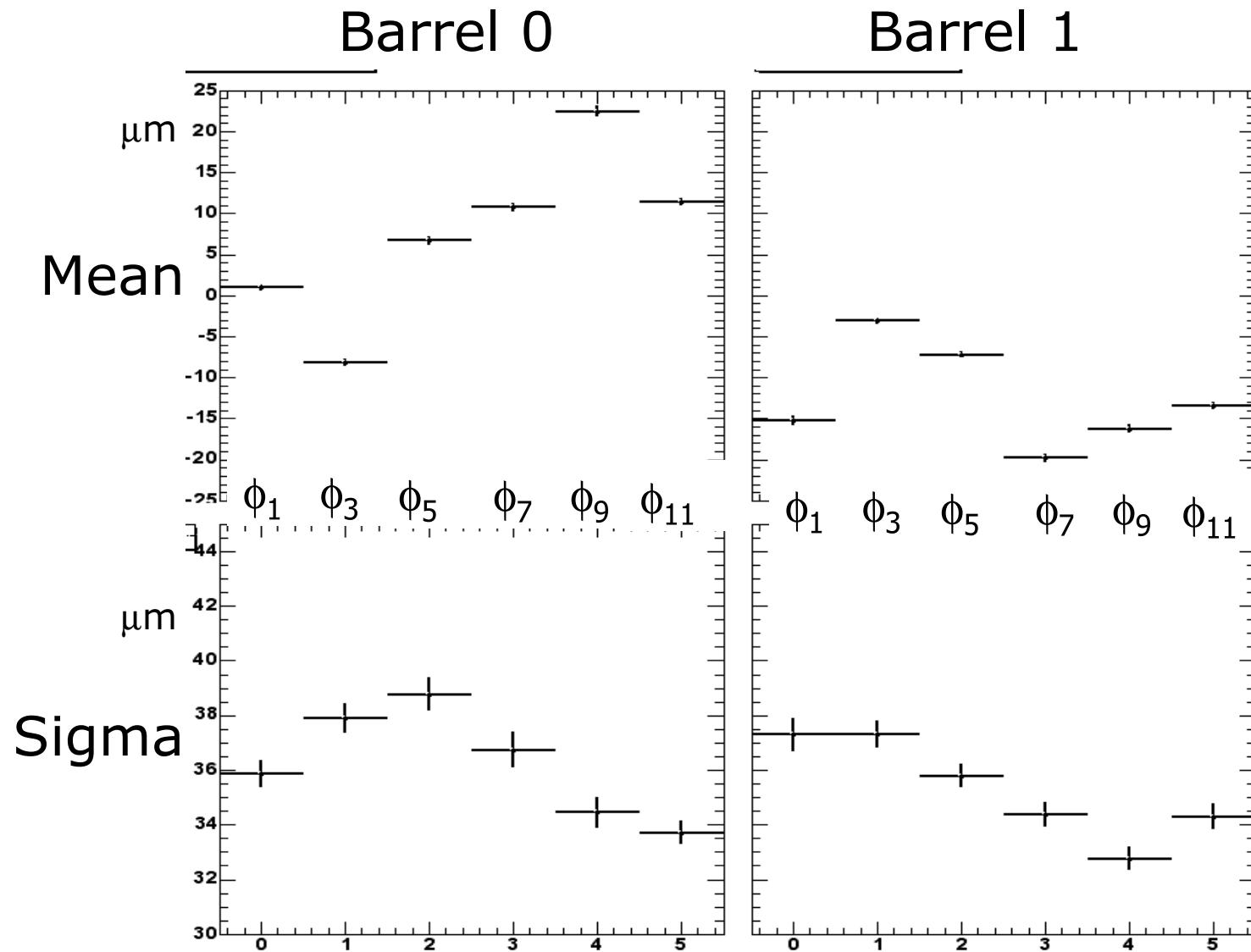
Typical fit result
for b1 $\phi 4$



Inner radius residuals



Outer radius residuals



Conclusions

- Overall efficiency relatively stable in time (2-3% spread for most ladders)
- Total Q deposited and no. of strips in cluster have largest impact on efficiency
- Several central inner ladders show poor performance during the year
 - Cause unknown
 - Great if they can be corrected offline
- Efficiency correlated with ladder proximity to beamspot (live with it for data collected and fix it in the future?)
- Much thanks to Matt & David & Tim & Ben for helping me get started